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PROJECT: SOIA-7-085(064)160

PCN: 19326

LOCATION: Alexander Bypass

LENGTH: 3.5 Miles

DATE: September 9, 2013

SUBJECT: Revised Linear Soils Report and Recommendations

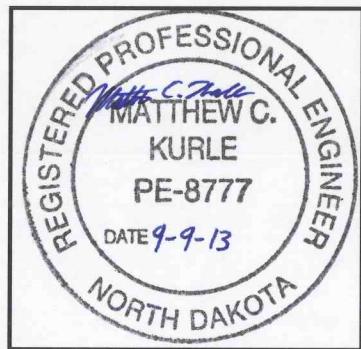
Attached is the Revised Linear Soils Report and Recommendation for the above referenced project. This report will supersede the report issued on 9/5/2013. If there are any changes made to the project after the report is issued that may require alteration to this recommendation or if you have any questions please contact Matt Kurle at 328-6924 or mkurle@nd.gov.

SOIA-7-085(064)160

Alexander Bypass

CERTIFICATION

I hereby certify that this report was prepared by me or under my direct supervision and that I am a duly registered professional engineer under the laws of the State of North Dakota. This document was originally issued and sealed by Matthew C Kurle, Registration number PE-8777 on 9/9/13 and the original document is stored at the North Dakota Department of Transportation.



Matthew C. Kurle
Matthew C Kurle, P.E.

9 SEPT, 2013
Date

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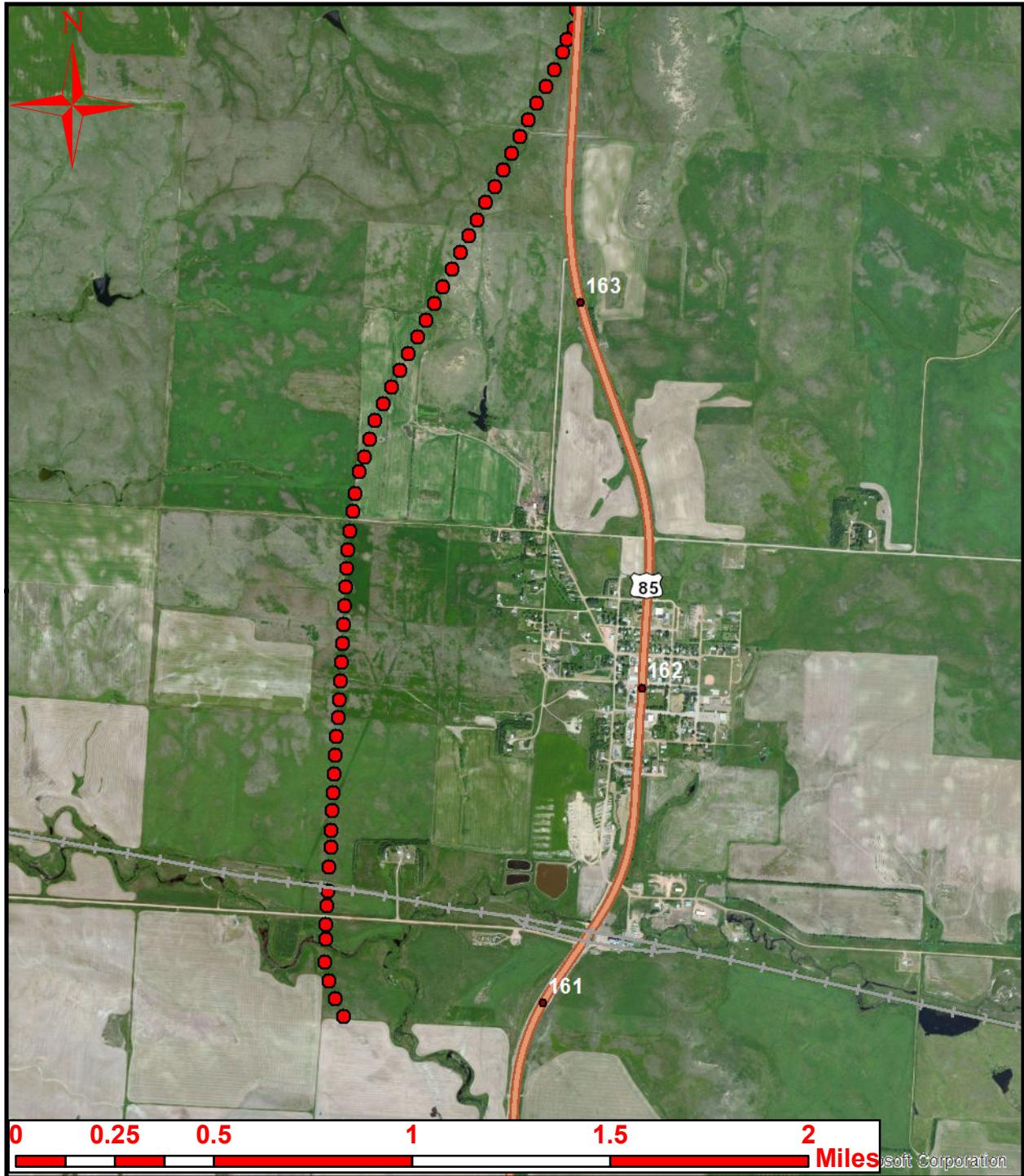
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- Appendix B – Summary of Soil Analysis



Linear Soils Survey

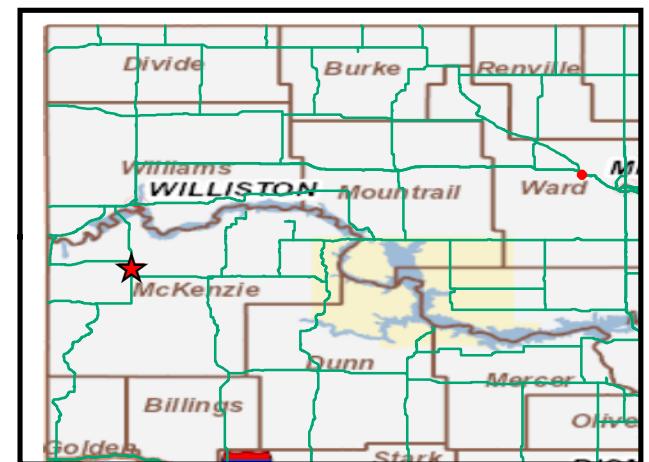
Project: SOIA-7-085(064)160

PCN: 19326

Scope: Grading

Length: 3.5 Miles

Location: Alexander Bypass



Introduction

This report will provide soils information and recommendations for the proposed Alexander Bypass on Highway 85. This Report is based on the Alternative B alignment and profile provided by KLJ Engineering. This alignment is shown in Appendix A.

Soil Borings

The soil borings were performed from 6/24/2013 to 6/26/2013 using a 6 inch solid flight auger. The borings were conducted at 250 foot intervals along the proposed alignment centerline. This alignment can be found in Appendix A of this report. Borings were performed from Sta 8510+00 to Sta 8651+00. Borings from Sta 8470+00 to Sta 8510+00 were not performed due to not being able to gain access to the land. The borings were advanced at variable depths based on the proposed profile.

Summary of Soil Analysis

Soil Descriptions

The analysis of the project yielded several different soil types present. The sample distribution is shown on the following figure.

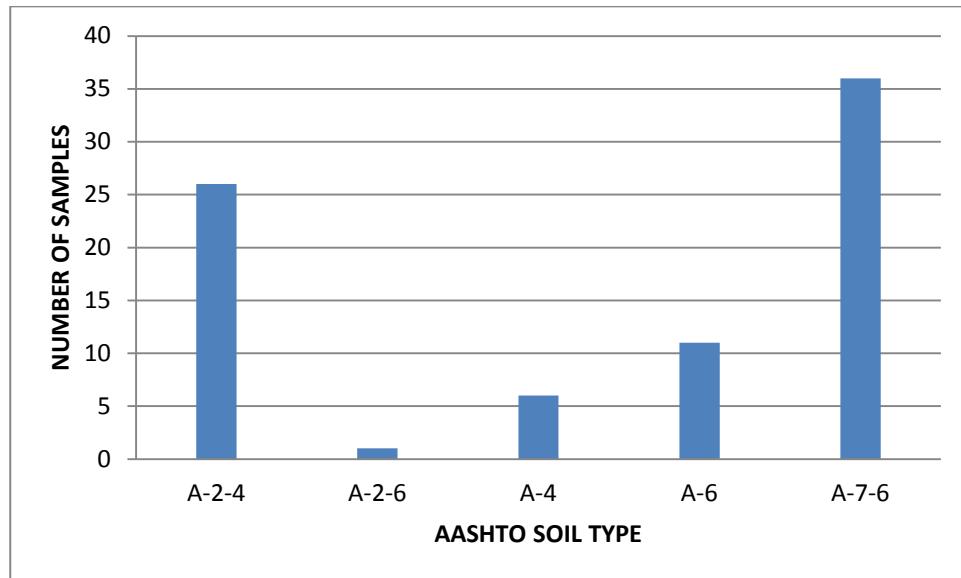


Figure 1 - Soil Sample Distribution

AASHTO A-2-4 soils consist primarily of granular materials containing 35 percent or less passing the No. 200 sieve. This includes such materials as gravel and coarse sand with silt contents or plasticity indexes in excess of the limitations of Group A-1. These soils function well as subgrade material.

AASHTO A-4 soils typically contain nonplastic silts. These may have an affinity for water and may swell unless they are properly compacted and drained

AASHTO A-6 soils typically consist of plastic clays. They usually have high volume change between wet and dry states. These soils have dry strength but lose much of this strength upon absorbing water. The A-6 soils will compress when wet and shrink and swell with changes in moisture content. They do not drain readily and may absorb water by capillarity with resulting loss in strength. These soils can also be highly frost susceptible although they will perform well when moisture is kept near the optimum value

AASHTO A-7-6 soils possess many of the A-6 characteristics except that they have high liquid limits and may be elastic as well as subject to extremely high volume changes. The plasticity index in these soils is high in relation to liquid limit.

Moisture

The moisture contents provided in this report and summarized below have been obtained from samples taken on 6/24/2013 to 6/26/2013.

Table 1 - Summary of In-Place and Optimum Moisture Contents

Quantity	AASHTO Classification	In-Place Moisture Range (%)	In-Place Moisture Average (%)	T-180 Optimum Moisture Average (%)	Difference Between Average In-Place and T-180 Optimum Moistures (%)
26	A-2-4	5.1-21.4	10.3	10.7	0.4
1	A-2-6	-	12.5	10.5	2.0
6	A-4	4.7-24.5	15.5	10.1	5.4
11	A-6	6.4-28.0	16.0	11.3	4.7
36	A-7-6	6.4-60.6	19.6	13.3	6.3

*Moisture contents taken from samples with high coal content are not included in this table

Table 2 - Summary of In-Place versus Optimum Moisture Contents

In-Place Moisture vs. Optimum Moisture						
Quantity	AASHTO Classification	Below Optimum	Optimum to Moderate (0 to 6% over optimum)	Moderate to High (6 to 10% over optimum)	High (10 to 16% over optimum)	Very High (> 16% over optimum)
26	A-2-4	46%	46%	8%	-	-
1	A-2-6	-	100%	-	-	-
6	A-4	17%	33%	33%	17%	-
11	A-6	-	73%	18%	9%	-
36	A-7-6	3%	30%	39%	25%	3%

Atterberg Limits

Table 3 - Summary of Atterberg Limits

AASHTO Classification	Liquid Limit Range (%)	Liquid Limit Average (%)	Plastic Limit Range (%)	Plastic Limit Average (%)	Plasticity Index Range (%)	Plasticity Index Average (%)
A-2-4	NP-25	25	NP-20	20	NP-5	5
A-2-6	-	36	-	12	-	24
A-4	NP-26	25	NP-20	18	NP-8	7
A-6	28-40	34	13-22	16	12-25	18
A-7-6	41-77	50	14-24	17	24-55	33

*The averages are based on the samples that were tested for respective atterberg limits.

Swell Potential

The swell potential, which is based on the Plasticity Index (PI), is shown in the following table.

Table 4 - Swell Potential

Low (Plasticity Index < 25)	Marginal (25 ≤ Plasticity Index ≤ 35)	High (Plasticity Index > 35)
56%	34%	10%

Frost Susceptibility

None of the samples obtained were F4 soils. The F4 designation indicates that under the right conditions these soils have a higher probability of heaving during freeze/thaw cycles.

Group Index

The Group Indexes from the samples ranged from a low of 0 to a high of 63. A group index of 20 or greater indicates a “very poor” subgrade material. The following table shows the respective group indices.

Table 5 - Group Indices

AASHTO Classification	Group Index Range	Group Index Average
A-6	2-18	9
A-7-6	15-63	25

Coal

Small traces of coal were encountered in several of the samples throughout the project. A significant amount of coal was encountered in the cut section from Sta 8555+00 to 8560+00. The coal encountered in this area is above the proposed subgrade profile according to the boring logs. This coal should not be used for fill and should be wasted. Coal has poor engineering properties and is not desirable in roadway embankment construction.

Design Recommendations

The analysis of the soils shows that the moisture contents were on average, 4.7% above the T-180 optimum moisture contents. The majority of the soil has acceptable engineering properties and is performing well. In the cut areas, moisture contents will be higher as the cut gets deeper. One specific cut area at Sta 8510+00 was identified that has potential to perform poorly. In this area we recommend that 400 feet of 18 inch subcut be performed.

The following information should be incorporated into the plans:

Design Information

Subcut:

18" subcut from Sta 8508+00 to 8512+00

Remarks:

Subcut 18" below the top of the proposed grade. Place reinforcement fabric (R1) at the bottom of all subcut excavations and backfill with Class 3 or Class 5 aggregate. Place 12" of aggregate on the fabric prior to compacting. Do not scarify the bottom of the subcut.

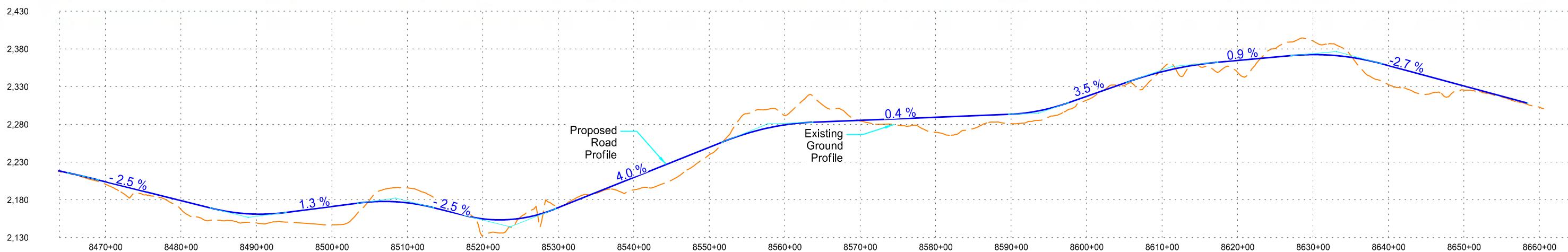
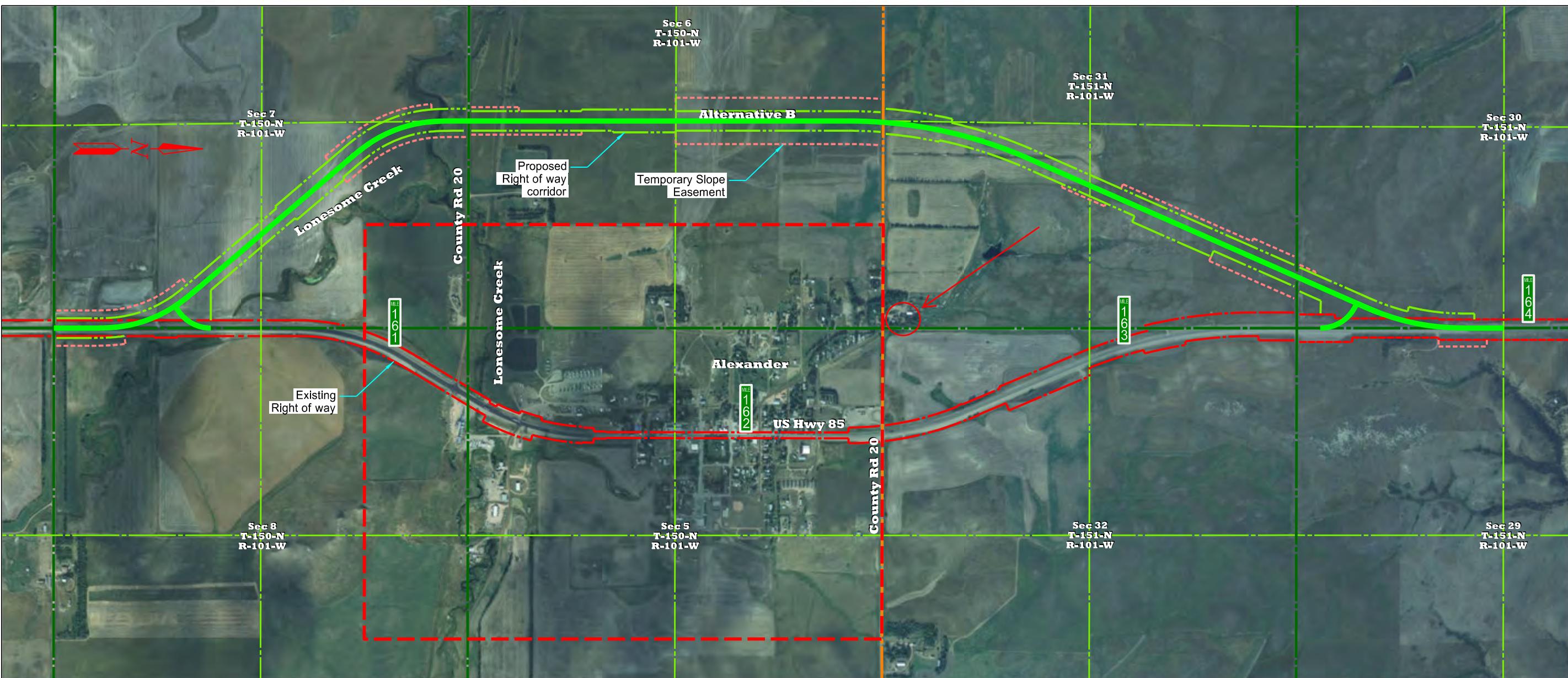
Plan Notes

None

The recommendations in this report are based on the alignment and profile provided to us prior to the borings being performed. If the scope of work, vertical profile or horizontal alignment is changed, in either the conceptual phase or the design phase, Materials and Research must be notified as soon as possible to ensure that there is adequate geotechnical information addressing these areas.

APPENDIX A

Alignment and Profile Alternative B



APPENDIX B

Summary of Soil Analysis

